CLAIMS

1. A method for adjusting capacitance of an on-chip capacitor, comprising the steps of:

providing the on-chip capacitor, wherein the on-chip capacitor has at least one material layer having a dielectric constant that defines a capacitance of the on-chip capacitor; and

exposing said at least one material layer to an ion beam comprising ions of at least one material, thereby modifying the dielectric constant of said at least one material layer to effect a change in said capacitance of the on-chip capacitor.

2. The method of claim 1, wherein said at least one material layer is comprised of at least one of silicon dioxide (SiO_2), barium-strontium titanate $(Ba,Sr)TiO_3$, porous organosilicate, titanium oxide, tantalum oxide, zierconium oxide, yittrium oxide, aluminum oxide, and silicon nitride.

3. The method of claim 1, wherein said at least one material comprises at least one of fluorine (F_2), oxygen (O_2), and nitrogen.

4. The method of claim 1, wherein said ion beam is a focused ion beam having a controlled concentration of ions.

5. An on-chip capacitor formed on a substrate, comprising:

a plurality of conductive layers; and

at least one insulative layer separating said plurality of conductive layers, wherein said at least one insulative layer comprises a material that was exposed to an ion beam, thereby modifying a dielectric constant of said material.

6. The on-chip capacitor of claim 5, wherein said material comprises at least one of silicon dioxide (SiO_2), barium-strontium titanate $(Ba,Sr)TiO_3$, porous organosilicate, titanium oxide, tantalum oxide, zierconium oxide, yittrium oxide, aluminum oxide, and silicon nitride.

7. The on-chip capacitor of claim 5, wherein said ion beam comprises ions of at least one of fluorine (F_2), oxygen (O_2), and nitrogen.

8. The on-chip capacitor of claim 7, wherein said ion beam is a focused ion beam having a controlled concentration of ions.

9. A method for adjusting capacitance of an on-chip capacitor formed on a substrate, comprising the steps of:

providing the substrate to a substrate processing chamber having a substrate support pedestal and a substrate positioning system;

irradiating a dielectric material of the on-chip capacitor using an ion beam comprising of ions, thereby modifying a dielectric constant of said dielectric material to effect a change in a capacitance of the on-chip capacitor; and

monitoring said capacitance of the on-chip capacitor.

10. The method of claim 9, wherein said dielectric material comprises at least one of silicon dioxide (SiO_2), barium-strontium titanate (Ba,Sr)TiO_3, porous organosilicate, titanium oxide, tantalum oxide, zierconium oxide, yittrium oxide, aluminum oxide, and silicon nitride.

11. The method of claim 9, wherein said ion beam comprises at least one of fluorine (F_2), oxygen (O_2), and nitrogen.

12. The method of claim 9, wherein said ion beam is a focused ion beam having a controlled concentration of ions.

13. The method of claim 9 wherein said irradiating step is implementing in accordance with at least one processing parameter, wherein said at least one processing parameter defines a concentration of said ions, an intensity of said ion beam, or a time duration of applying said ion beam.

14. An apparatus for adjusting capacitance of an on-chip capacitor formed on a substrate, comprising:

a substrate processing chamber having a substrate support pedestal and a substrate positioning system;

a source of an ion beam for irradiating a dielectric material of the on-chip capacitor;

a system for measuring a capacitance of the on-chip capacitor; and

a controller configured to control said source to irradiate the on-chip capacitor, thereby modifying a capacitance of the on-chip capacitor.

15. The apparatus of claim 14, wherein the dielectric material comprises at least one of silicon dioxide (SiO_2), barium-strontium titanate $(Ba,Sr)TiO_3$, porous organosilicate, titanium oxide, tantalum oxide, zierconium oxide, yittrium oxide, aluminum oxide, and silicon nitride.

16. The apparatus of claim 14, wherein said ion beam comprises ions of at least one of fluorine (F_2), oxygen (O_2), and nitrogen.

17. The apparatus of claim 16, wherein said controller operates said source to control a concentration of ions applied to the on-chip capacitor, an intensity of the ion beam, and a time duration of irradiating a dielectric material of the on-chip capacitor.

18. The apparatus of claim 14, wherein the ion beam is a focused ion beam having a controlled concentration of ions.